

# Electronic voting and Social Spending: The impact of enfranchisement on municipal public spending in Brazil\*

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## Abstract

This article studies the effect of introducing electronic voting in Brazil on municipal level public spending. A theoretic, political economy model suggests that, by *de facto* enfranchising the poor, electronic voting increased social spending. This prediction is then empirically tested using as instrument the gradual introduction to electronic voting (EV), which affects voting enfranchisement without directly influencing public spending. We apply two different methodologies: a 2SLS regression and a differences-in-differences methodology to show that municipalities using EV spend more on health, education and public employment compared to the ones that did not, which confirmed the hypothesis presented in our model.

**Key words:** Electronic voting; political participation; politically motivated intergovernmental transfers; social public spending.

**JEL Classification:** H72, D72, H77

## Resumo

Este trabalho avalia o efeito da introdução da urna eletrônica no Brasil sobre o gasto público municipal. Primeiramente, um modelo teórico de economia política sugere que, ao facilitar o acesso dos pobres ao voto, a urna eletrônica deve ter causado aumento nos gastos sociais dos municípios. Essa previsão é testada empiricamente fazendo-se uso como instrumento da introdução gradual da urna eletrônica, que afetou o acesso dos pobres, sem afetar diretamente o gasto público. Aplicamos duas metodologias distintas: a regressão em dois estágios e a metodologias das diferenças em diferenças. O estudo mostra evidência de aumento nos gastos em saúde, educação e emprego público nos municípios que usaram a urna eletrônica, em comparação com aqueles que não usaram, confirmando a previsão do modelo.

**Palavras-chave:** Urna eletrônica; participação política; transferências intergovernamentais partidárias; gasto público social

**Classificação JEL:** H72, D72, H77

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## 1- Introduction

The discussion associating voters' demands to their income has an early tradition. Alexis de Tocqueville in his seminal book "Democracy in America" argued that allowing those who do not own property to vote would increase the proportion of voters who are in favor of income redistribution. Theoretical models also predict that an increase in voting participation of poorer voters increases social spending (Meltzer and Richards, 1981). Many empirical works attempt to confirm this prediction as well.<sup>1</sup> However, it has remained a challenge to find an identification strategy that solves the reverse causality problem of regressing directly government spending on voting participation. Namely, the more the government spends, the more likely poor people will be to turnout to vote to maintain the status quo.

This work uses the electronic voting (EV) gradual introduction in Brazil – which increased voters' probability of casting a valid vote without directly affecting social spending – as an instrument to solve the discussed reverse causality. We show that voting enfranchisement biased toward poorer voters increase social spending. Our main contributions to the literature are: present a theoretical model; use alternative empirical strategies; and expand Fujiwara's (2015) analysis to municipalities and to other social spending outcomes.<sup>2</sup>

Voting in Brazil is mandatory, which makes voting turnout high, but not necessarily guarantees a large percentage of valid votes. Brazil has a turnout-to-electorate level of 80% on average.<sup>3</sup> However, before EV, only 58% of votes for Representatives were valid.<sup>4</sup> Therefore, congressmen could ignore the voice of voters that were not able to cast a vote, which, as argued in this work were mostly poor.<sup>5</sup> After EV, the valid vote to turnout ratio increased to 92% and the main purpose of this work is to associate this *de facto* enfranchisement to municipal level public

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<sup>1</sup> See, for instance, Meltzer and Richards (1983); Lindert (2004); Mueller and Stratmann (2003); and Oliveira (2005).

<sup>2</sup> Fujiwara (2015) focused his analysis to Brazilian states and measured the impact of poor citizens' enfranchisement on health spending and health outcomes.

<sup>3</sup> In the United States, for instance, this number is close to 60%.

<sup>4</sup> In the 1994 elections, before EV, the valid vote to turnout ratio for Federal Representatives was only 58%. While in 2002, when EV was used in all polling stations in the country this number increased to 92% according to the Supreme Electoral Court (*Tribunal Superior Eleitoral*, TSE).

<sup>5</sup> The valid vote for executive elections were almost not affected by EV.

spending, which we find to increase.

First, we build a theoretical model allowing voters to cast, not purposefully, an *invalid* vote, and show that when poorer voters' likelihood of casting a *valid* vote increase, social spending increases as well. Next, we propose a two stage least square regression (2SLS), using EV as instrument, to directly test and confirm our model prediction. Finally, we present a differences-in-differences (DID) model, where municipalities using EV is our treatment group, to expand our sample analysis and bring external validity to our 2SLS estimation.

The proposition that poor voters' enfranchisement increase social spending has an early tradition and our empirical model corroborates this finding. Our model considers specificities of the Brazilian elections to add two assumptions not commonly used in the literature: voting is mandatory so all voters are necessarily turning out to vote; and voters may *incorrectly* cast their votes. Interestingly, as EV not only decreases the number of *invalid* votes, but also bias this reduction towards the poor (Fujiwara, 2015), the model predicts that the provision of public goods should increase because the poor are the ones more likely to demand public goods and at the same time, to be *de facto* enfranchised.

Besides presenting a theoretical model, this work uses two econometric methodologies to test its conclusion. Both explore the fact that, due to a limited supply of voting machines in the 1998 federal elections, only municipalities belonging to four selected states and places with more than 40,500 voters used EV.<sup>6</sup>

First, we estimate a 2SLS regression to measure the impact of poor voters' enfranchisement on government spending at the municipal level during the last two years of the mayor's four years' term (i.e., 1999 and 2000).<sup>7</sup> EV assignment is used as instrument and to guarantee that its usage is the only difference between the compared municipalities, the analysis contains only municipalities which number of eligible voters is close to 40,500.

Next, we consider a larger sample and provide external validity to our 2SLS findings by using a DID analysis containing 92% of all municipalities. To use this methodology, we consider the four states that had EV in all their territories as the treatment group and the remaining ones as the control group. We restrict our sample to municipalities with less than 40,500 voters to avoid heterogeneity between the two groups. Then, we compare the differences between the amount of public expenditure on the treatment and control groups before EV usage (i.e., last two years of the mayoral term that ended in 1996) and after it (i.e., last two years of the mayoral term that ended in 2000).

Our two models find similar estimates on the impact of EV on social spending. To preview our findings, our 2SLS estimation shows that an increase of 1 p.p. in the valid votes to turnout ratio for state representatives increases health spending by 1.65%; public employment by 0.71%; total spending by 1%; total revenue by 0.95% and intergovernmental transfers by 1.5%. Our DID model estimates shows that an increase of 1 p.p. in the valid vote to turnout ratio for Representatives increases health spending by 1.42%; public employment by 1.28%; total spending by 1.26%; total revenue by 1.07% and intergovernmental transfer by 1.11%. Both methodologies present close results, even though the sample we use is different, which brings external validity to our 2SLS estimation and increase the robustness of our results.

Besides the introduction, this work is divided as follows. Section 2 presents a literature review on the connection between voting participation and public spending and discusses the EV implementation. Section 3 presents a model that motivates the empirical analysis. Section 4 briefly discusses the data collection. Section 5 presents the 2SLS model and Section 6 the differences-in-differences. Finally, section 7 concludes the work.

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<sup>6</sup> EV was then used in all municipalities after the 1998 elections.

<sup>7</sup> As we discuss later in further detail, federal elections and municipal elections in Brazil have a two-year gap between them.

## 2- Background

### 2.1. Voters' enfranchisement and public spending

Meltzer and Richard (1981) show that voting enfranchisement increases public spending. Using a model of electoral competition, they argue that the median income voter is the one imposing her preferences on public spending. Moreover, the electoral equilibrium shows that the poorer the median income voter is the larger will be her public spending optimum provision demanded. This result comes from the fact that, the poorer the citizen is, the lower will be her tax contribution to finance the public provision. Lindert (2004) developed an econometric study using decennial data from OECD countries between 1880 and 1930 to confirm the positive relationship between government size and vote participation. In Latin America, Brown and Hunter (1999) study the relationship between democracy and public social spending using panel data for 17 countries between 1980 and 1992. The authors conclude that, especially in poor and economic instable countries, democracy increases the allocation of public spending on social programs when compared to dictatorship regimes.

In the United States, Husted and Kenny (1997) analyze 46 American states between 1950 and 1988. During this period, restrictions to vote focused mainly on the poor, such as poll taxes payments and literacy tests, were banned in the country, thereby increasing voting participation and, at the same time, decreasing the income of the median voter. Therefore, it should come as no surprise the result found on their study showing that a reduction of 0.2 on the median voter income to the total population income ratio caused an increase of 5 to 12% on public social spending.

Nonetheless, Meltzer and Richard's (1981) argument is not consensual. Alesina and Giuliano (2009), for instance, argue that the empirical studies are limited and other aspects such as the median voter's perspective on social mobility and strength of lobbying groups could reinforce the limits imposed on government intervention in the economy. A possible way to explain the difficulty to find empirical evidence on the relationship between the median's voter income and public spending is given by the fact that the median income of the citizen may not be the same as the median income of those who show up to vote and cast valid votes. That is, even if democracy allows all eligible voters to cast their votes, those who do not vote may have their preferences completely ignored by politicians. Mueller and Stratmann (2003), for example, find that there is a positive relationship between turnout and public spending.

Therefore, democracy by itself is not enough to guarantee larger public spending. According to UNDP (2005), between 1990 and 2002, less than 55% of all eligible voters living in a democracy showed up to cast a vote to a candidate (or party). More importantly, those abstaining to vote are more likely to represent the poor (and illiterates). Frey (1971) shows a positive relationship between income and electoral participation in the United States. Weeks (2014) finds that "According to U.S. Census, 47 percent of eligible adults with family incomes of less than \$20,000 a year voted in 2012 [...] By contrast, those with annual earnings of \$100,000 or more turned out at rates of around 80 percent". Greene and Nikolaev (1999) using electoral polls between 1972 and 1993 concluded that electoral participation monotonically increases with income. Borgonovi et al. (2010) show a positive relationship between education and electoral participation in 15 European countries. In Brazil, Elkins (2000) finds a positive relationship between political concern and education.

As Bugarin and Portugal (2015) argue, lower political participation concentrated on the poor makes the median voter income to be larger than the median citizen income reducing the preferences for public goods. A solution pointed by these authors is to use mandatory voting.<sup>8</sup> Jackman (2001) uses the Australia elections to show how mandatory voting increase voting participation (the turnout has increased from 65% to 95% after mandatory voting was imposed in this country). However, mandatory voting by itself cannot guarantee voting participation. As aforementioned, Brazil's case is illustrative. Although the constitution makes it mandatory for all

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<sup>8</sup> According to The Economist (2015), 38 countries use or has used mandatory voting in their elections.

literate citizens between 18 and 70 years old to vote,<sup>9</sup> in 1994 for instance, less than 60% of those who showed up to vote (turnout close to 80%) cast a valid vote for a candidate or party to the legislative seats.

## 2.2 Electronic voting and political participation in Brazil

In Brazil, there are elections every other year as Figure 1 shows. For instance, in 1994, the federal elections elected the Federal and State Representatives; senators; governors and president. Two years later, the municipal elections elected the municipal representatives and mayors.<sup>10</sup> EV was first implemented in the 1996 municipal level elections. All municipalities with more than 200,000 eligible voters and the states' capitals used the new technology.<sup>11</sup> In the 1998 federal elections all Brazilian municipalities with more than 40,500 eligible voters<sup>12</sup> used the electronic voting system. Finally, in the municipal elections of 2000 and all the following ones every Brazilian voter could electronically vote.

As showed in the literature (Hidalgo, 2010; Moraes, 2012; Fujiwara, 2015), EV usage is responsible for an increase of 20 p.p. and 14 p.p. in the valid votes (correctly cast votes) to turnout ratio for federal and state representatives respectively. To cast a vote for Representative before EV, one should clearly write the name or number of the candidate in the ballot. Therefore, it was essential to know how to read to understand the ballot instructions and vote in Brazil.

The EV introduction made it easier for voters to cast a ballot. In the new system, the voter needs to press the candidate's number on a numerical keyboard<sup>13</sup> and after verifying the picture of the candidate, press a green button to confirm the vote.<sup>14</sup> The only way to cast an *invalid* vote, accidentally, is to type a candidate's number with no correspondence and press the green button after seeing the screen warning "this number is wrong".<sup>15</sup> As Hidalgo (2010) points out, the EV was considered a democratic progress since even illiterates could press a number followed by the green button after seeing their preferred candidates' face on the screen.

The main four works on EV in Brazil are Hidalgo (2010), Moraes (2012), Fujiwara (2015) and Schneider (2016). All these works converge to the fact that EV has increased political participation.<sup>16</sup> The last three works also show, although in different ways, that EV had a larger impact on enfranchisement in municipalities with a larger rate of illiteracy.<sup>17</sup> Hidalgo (2010), focusing on federal representatives' elections, shows that the party ideological choice (from left to right) suffered only a small effect due to EV that benefitted the right wing parties the most. Schneider (2016) showed that places where clientelism have stronger ties in Brazil had a decrease in turnout due to EV, which benefitted left-wing parties because clientelism is strongly related to right-wing parties. Therefore, disenfranchisement helped the former parties. Moraes (2012) studies the increase in electoral competition resulted by EV usage and Fujiwara (2015) focuses on the public health spending at the state level in Brazil showing that the larger the percentage of voters using EV within a state, the larger the amount of health spending and consequently the better the

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<sup>9</sup> All Brazilian citizens, age 16 and older have the right to vote. Illiterate citizens are not mandated to vote.

<sup>10</sup> Both municipal and federal elections grant a four years term to the ones elected (except senator that get an 8 year term). In addition, a two years distance separates these two elections.

<sup>11</sup> Only 57 municipalities used EV in 1996.

<sup>12</sup> Four states used EV in all their territories independent of the number of eligible voters (Rio de Janeiro, Amapá, Alagoas and Roraima).

<sup>13</sup> Similar to a regular phone keypad commonly used in Brazil at the time according to Hidalgo (2010). Note that Brazilians are intensive users of cellular phones; by the end of November 2016 there were 248.4 million active cellular lines in Brazil, which corresponds to 1.2 cellular phone line per citizen in Brazil (<http://www.teleco.com.br/ncel.asp>).

<sup>14</sup> Fujiwara (2015) shows illustrations of the old ballot comparing it to the electronic one. It is also important to notice that the government had made TV advertisement teaching how to vote in the new system and trained people to help voters if something went wrong during the voting process in the Election Day.

<sup>15</sup> The voter could not cast a vote on purpose by pressing a white button (blank vote) followed by the green one to confirm it.

<sup>16</sup> By increasing the valid votes to turnout ratio close to 22%.

<sup>17</sup> Schneider (2016) also shows that EV had a larger impact on enfranchisement in municipalities with lower GDP per capita.

health outcomes in these places.

This article brings new results and intuition on how enfranchisement affects public spending. Differently from Fujiwara (2015), our work relies on municipal level data and shows that not only health, but also public employment, education and the overall municipalities' public expenditures increase due to EV usage.<sup>18</sup> Also, this work shows that the municipal revenue, mostly composed by federal and state transfers, of places that used EV in 1998 disproportionately increased explaining how these municipalities could spend more on public goods.

### **3 – The effect of electronic vote on the electoral outcome: A political economy model**

#### **3.1 Foundations**

Section 3 builds a voting model aimed at better understanding the effect of EV on the electoral equilibrium. The model distinguishes to different stages of voters' decision; first, a voter decides whether to vote. Next, if the voter decides to vote, then she will decide to which party to vote for.

A voter's decision to vote is one of the most discussed issues both in Political Sciences and in Economics as well. Indeed, considering that there is a cost associated to voting, a rational agent will choose to vote only if she believes it is reasonably likely that her vote will change the electoral outcome. Chamberlain and Rothschild (1981) prove that under rather general conditions, the probability that a voter will cast the decisive vote in an election between two alternatives (parties) in which there are  $2N+1$  voters is of order  $N^{-1}$ . Therefore, in large elections the probability of a voter being pivotal is negligible.<sup>19</sup> But then, electoral participation should be reduced, as also suggested in Downs (1957, p. 260-276).

However, actual electoral data show a much higher level of electoral participation, even in countries where voting is not mandatory. For instance, the 2012 US presidential elections showed a record low participation level of 57.4%, which is much higher than social choice theories would predict.

Both experimental and theoretic studies aim at understanding why people vote. Blais and Young (1999) conclude that a feeling of civic duty is a strong factor that makes people vote, based on an experiment conducted by the Canadian Electoral Commission. Schram and Winden (1991) present a theoretic model that also assumes the civic duty motive but adds the issue of group identification and the fact that the larger the number of votes a group obtains, the more it is able to affect public policy as well; it concludes that members of a group will pressure the other members to vote. This second theoretic motive for voting is supported by Schram and Sonnemans' (1996) experimental study. Edlin, Gelman and Kaplan (2007) present a model in which a citizen's utility has a social component, i.e., she cares about the other citizens' welfare; the model shows that there will be higher voting participation than when a citizen has the typical selfish utility. Harder and Kronick (2008) stresses that the social environment and the difficulties a citizen faces to vote (due to lack of literacy, for example) affect the willingness to vote. Finally, Feddersen and Sandroni's (2006) model assumes that citizens care about the aggregate social cost of voting and introduces the concept of "ethical rules" that determine which citizens will vote in equilibrium; the model endogenizes a concept similar to the exogenous concept of civic duty as part of the equilibrium solution.

In the present paper we use the concept of "willingness to vote" as a proxy for all the motives for voting described above. In our model each citizen  $i$  has a willingness to vote  $v_i \in V \subset \mathbb{R}_+$ . The willingness  $v_i \geq 0$  represents the utility gain agent  $i$  receives when she votes, regardless of the final result of the election. Note that, since the citizen understands that her vote is insignificant, her decision on whether or not to vote depends on the comparison between the cost of voting and

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<sup>18</sup> Fujiwara (2015) analyses state level data (27 observations).

<sup>19</sup> According to John Longredan, "[...]the chances of actually influencing an election are about the same as getting hit by lightning" (in Carey, 2008).

her willingness to vote. If the cost is lower than the willingness to vote, the agent will then decide to participate and will vote sincerely, for the party that better represents her preferences.

Hence, our electoral analysis will be divided in two steps. In the first step, each citizen decides whether to vote, based on her cost to vote and on her willingness to vote. In the second step, those who decided to vote cast their ballots.

### 3.2. First step: The decision to vote

#### *Primitives of the model*

There is a continuum of agents of mass 1,  $W = [0,1]$ . Each agent  $i \in W$  has a type  $v_i \in V \subset \mathbb{R}_+$  – her willingness to vote. In particular, if  $v_i = 0$ , then agent  $i$  sees no value in voting. The willingness to vote  $v_i$  is a continuous random variable distributed in a non-negative set  $V$  according to the distribution  $F(v_i)$ .

If she decides to vote, citizen  $i$  will incur a cost  $\kappa_i \in \mathbb{R}_+$ . The cost reflects a number of components. Directly, it reflects the displacement costs, the opportunity cost of time, etc. Most importantly, it reflects the cost of gathering the information she needs in order to decide who to vote for, as well as preparing for filling properly the complex voting cell. This is the component that will matter in the present model as it may change according to the voting technology (discussed previously).

#### *General electoral participation*

An agent of type  $v_i$  and cost  $\kappa_i$  will decide to vote if and only if:

$$v_i - \kappa_i \geq 0. \quad (1)$$

Let  $E = \{i \in W \mid v_i - \kappa_i \geq 0\}$  be the set of voting citizens. Then the cardinality of  $E$ ,  $|E|$ , corresponds to the proportion of voting citizens. Note that the higher the expected value of the willingness to vote, the higher the overall electoral participation, ceteris paribus. More importantly for the present study, the lower the voting costs, the higher the proportion of voting citizens, ceteris paribus.

An illustration of the voting costs associated to legal requirements can be found in Brazilian institutions. Before the 1988 Brazilian Constitution voters were required to be literate in order to vote; therefore, an illiterate citizen would have to first learn how to read and write in order to have access to voting. Similarly, before the 1960s several American States required citizens to pass literacy tests in order to vote; that, in practice, reduced the vote of the black citizens for whom these tests were typically difficult (Husted and Kenny, 1997).

These examples suggest that poorer citizens tend to have lower electoral participation. Indeed, several empirical studies suggest that this is the case, as reviewed in Bugarin and Portugal (2015). In what follows we include such a friction in the original model.

#### *Different electoral participation by social classes*

Suppose now that society is divided in three income classes. The low-income class  $P$  is formed of poorer citizens with income  $y^P$ . The middle-income class  $M$  congregates the middle class with income  $y^M$  and the high-income class  $R$  is composed of richer citizens with income  $y^R$ , where  $y^P < y^M < y^R$ . A class  $J = P, M, R$  has mass  $\alpha^J \in [0,1]$  where  $\alpha^P + \alpha^M + \alpha^R = 1$ . Suppose now that there is total orthogonality between income and willingness to vote, so that the willingness to vote is distributed in each class according to the same distribution function  $F(v_i)$ . Furthermore, suppose for simplicity that all citizens sharing the same income class share the same voting cost, i.e.,  $\kappa_i = \kappa^J$  for every citizen  $i$  class  $J, J = P, M, R$ . Finally, as discussed before, suppose that the cost of voting is higher for the low-income class, i.e.,  $\kappa^P > \kappa^M, \kappa^R$ .

Therefore,  $F(\kappa^J)$  corresponds to the percentage of citizens from class  $J = P, M, R$  that gives up voting. Hence,  $\alpha'^J = [1 - F(\kappa^J)]\alpha^J$  is the percentage of citizens that belong to class  $J$  and vote,  $\eta^J = F(\kappa^J)\alpha^J$  is the percentage of citizens that belong to class  $J$  and do not vote, and  $\alpha^J = \alpha'^J + \eta^J$ .

#### *The effect of the electronic vote on each class' electoral participation*

Our model allows us to investigate the effect of EV on each income class. Suppose that class  $P$ , besides being the poorer class, is also the class with lowest literacy levels, so that, it is also the class with highest voting costs with the older voting technology, because it requires memorizing and writing down the candidates' names, as discussed earlier. Then, the percentage of electoral participation will be lower in class  $P$  ( $\kappa^P > \kappa^M, \kappa^R \rightarrow 1 - F(\kappa^P) < 1 - F(\kappa^M), 1 - F(\kappa^R)$ ).

What would be the effect of implementing EV? We expect that the EV will create the highest changes precisely in class  $P$  that has the highest rate of illiteracy. In that class, the easier voting technology will reduce voting costs, from  $\kappa^P$  to  $\tilde{\kappa}^P < \kappa^P$ . As for the other classes, including citizens better able to read and write and with higher education levels, the effect of EV will be less significant. Hence, for simplicity we assume that EV does not affect the voting costs for the other two classes. Therefore, EV will allow higher participation rates for the poor class without significantly changing the participation rates in the remaining classes.

### 3.3. Second step: Electoral equilibrium with heterogeneous participation

#### *The basic ideas of the model*

The electoral competition model presented here follows Bugarin and Portugal (2015). Two parties simultaneously announce political platforms. A platform consists of a provision of a public good that will be produced if the party wins the election. Production of the public good is totally funded by taxes to be collected from every citizen according to a single tax rate. Since society is composed of three income classes, all citizens from the same class will have the same preferences for public good provision. Furthermore, since all citizens benefit the same way from public good consumption but the poorer ones pay fewer taxes for its production, typically the poorer classes prefer more public goods than the rich ones.

A percentage of citizens in each class does not vote. Those who vote will vote sincerely, for the party that better represents his preferences. Citizens' preferences take into consideration parties' platforms but are also influenced by unpredicted stochastic factors that are orthogonal to the announced platforms. Examples of such factors are sexual scandals or a terrorist attack, among others.

Elections are held in one national electoral district in which each voter has one vote. After the elections, each party is assigned a quantity of seats in the Legislature that corresponds to the percentage of votes it received. After the new Legislature is formed, the party that has a majority of seats (we assume an odd number of seats) implements its campaign platform: taxes are collected and the public good is provided. Figure 2 presents the general form of the game. Note that only the first and the third boxes correspond to agents' decisions. Furthermore, decisions in the third box are straightforward since voting citizens vote sincerely. The details of the electoral competition game and its solution are presented next.

#### *The electoral completion game with heterogeneous participation*<sup>20</sup>

Society is composed of three income classes, as previously described. Two parties  $P=A, B$  announce simultaneously a per capita level of provision of a public good,  $g_J, J = A, B$ , to be implemented by the winning party. Public good production is financed by an income tax collected according to the tax rate  $\tau$ , common to all agents. All tax-collected resources are used for the public good's provision. Then the government budget constraint is given by the equation below, where  $\sum_J(\eta^J + \alpha^J) y^J = \sum_J \alpha^J y^J = y$  represents the average income of all citizens.

$$\tau \sum_J(\eta^J + \alpha^J) y^J = \tau y = g. \quad (2)$$

A voter's utility has two components: a pragmatic component and an ideological one. This is the most general way of characterizing an economic agent who also has political concerns; for more on this topic, see Ferejohn (1986), Bugarin (1999) and Bugarin (2003). The pragmatic or *economic* part of the utility represents the voter's decisions as a *homo oeconomicus* and depends on the consumption of a private good, as well as the consumption of the public good. Thus, if a citizen of

<sup>20</sup> This section and the following section as well draw heavily on Bugarin and Portugal (2015).



class  $J$  has private consumption  $c^J$  and public good consumption  $g$ , its utility is  $c^J + H(g)$  where  $H$  is a twice differentiable, strictly increasing, and strictly concave function. In the present model public good provision and the corresponding income tax rate are the result of the electoral process; therefore, the *homo oeconomicus* will choose the highest possible private consumption, i.e.,  $c^J = (1 - \tau)y^J$ , and the resulting pragmatic component of his utility is:

$$(1 - \tau)y^J + H(g). \quad (3)$$

Hence, we can write that agent's pragmatic utility as  $W^J(g) = (y - g)\frac{y^J}{y} + H(g)$ . Therefore, her preferred public policy is:

$$g^{*J} = (H')^{-1}\left(\frac{y^J}{y}\right), \quad J = P, M, R. \quad (4)$$

Note that  $g^{*P} > g^{*M} > g^{*R}$ , i.e., the poorer a citizen is, the more favorable she is to public expenditure, as discussed before. This result is well known in the literature and has been carefully formalized in Meltzer and Richard (1981). It explains the increase in the size of governments throughout the 19th and 20th centuries as a consequence of the expansion of suffrage in the consolidating western democracies.

The ideological component of a voter's utility function reflects her concerns as a *homo politicus* and depends on two random variables corresponding to the voter's bias towards party  $B$ , or equivalently, party  $B$ 's popularity at the time the election is held.<sup>21</sup> The first random variable is common to all voters and relates to the realization of a state of nature that affects the entire population. A war, an abrupt change in international oil prices and a countrywide energy crisis are examples of such phenomena. A clear example is the popularity of the U.S. president after the terrorist attack on September 11<sup>th</sup>, 2001, which increased from 57% in February to 90% in September.<sup>22</sup> We model that process with a random variable  $\delta$  uniformly distributed on  $\left[-\frac{1}{2\psi}, \frac{1}{2\psi}\right]$ . The parameter  $\psi > 0$  measures the level of society's sensibility to these shocks: the lower the value of  $\psi$ , the more those shocks may affect society. To illustrate, price changes in oil may strongly affect the political equilibrium in a country that depends strongly on that product, such as Venezuela, and have much less effect in countries that produce near their internal demand levels, such as Brazil.

The second random variable is particular to each voter  $i$  in group  $J$  and reflects her personal bias towards party  $B$ . It relates to information about relevant politicians on issues that are not consensual in society, such as information that a candidate used drugs in his youth; some voters may believe that this fact makes the candidate unsuitable to a political leadership career, others may find no relation whatsoever with political career, others may even sympathize with the candidate. We model that bias as a random variable  $\sigma^{iJ}$  uniformly distributed on  $\left[-\frac{1}{2\phi}, \frac{1}{2\phi}\right]$ . Hence, the greater the parameter  $\phi$ , the more homogeneous class  $J$  is.

Therefore, if party  $B$  wins a majority of seats in the Legislature with platform  $g^B$ , voter  $i$  in the social class  $J$  derives utility:

$$W^J(g^B) + \sigma^{iJ} + \delta. \quad (5)$$

Note that it may be the case that the realization of  $\delta$  is positive, whereas the realized value of  $\sigma^{iJ}$  is negative. Suppose, for example, that the GDP of a country increases above expectations, which brings about overall support for the incumbent president's party, but the media releases the news of a sexual scandal in the presidential office, which may affect different voters in different ways.

### *The solution to the electoral competition game*

<sup>21</sup> Analogous results would obtain if we had set the bias with respect to party  $A$  due to the symmetry of the bias.

<sup>22</sup> See "Poll Analyses", Section "Gallup Poll News Service", The Gallup Organization, <http://www.gallup.com>, 09/24/2001.

We solve the game by backwards induction. Suppose party  $P$  announces policy  $g^P$ ,  $P = A, B$ . Then, voter  $i$  in class  $J$  prefers party  $A$  to party  $B$  if and only if:

$$W^J(g^A) > W^J(g^B) + \sigma^{iJ} + \delta. \quad (6)$$

Then, the voter that is exactly indifferent between the two parties in class  $J$  corresponds to the realization  $\sigma^J$  of the random variable  $\sigma^{iJ}$  given by the following equation  $\sigma^J = W^J(g^A) - W^J(g^B) - \delta$ .

Since citizens vote sincerely, the number of votes party  $A$  receives is:

$$\pi^A = \sum_J \alpha'^J \cdot \text{Prob}[\sigma^{iJ} \leq \sigma^J] = \sum_J \alpha'^J \left[ \sigma^J + \frac{1}{2\phi} \right] \phi = \sum_J \alpha'^J \sigma^J \phi + \frac{\alpha'}{2}. \quad (7)$$

Define  $W'(g^A) = \sum_J \alpha'^J W^J(g^A)$  and  $W'(g^B) = \sum_J \alpha'^J W^J(g^B)$ . Then the probability of victory of party  $A$  is:

$$p^A = \text{Prob} \left[ \pi^A \geq \frac{\alpha'}{2} \right] = \text{Prob} \left[ \delta \leq \frac{1}{\alpha'} [W'(g^A) - W'(g^B)] \right]. \quad (8)$$

The above expression can be rewritten as:

$$p^A = \frac{1}{2} + \frac{\psi}{\alpha'} [W'(g^A) - W'(g^B)]. \quad (9)$$

By symmetry, the probability of victory of party  $B$  is:

$$p^B = \frac{1}{2} - \frac{\psi}{\alpha'} [W'(g^A) - W'(g^B)]. \quad (10)$$

Parties choose their announced platforms in order to maximize their probability of winning the election given by (9) and (10). Therefore, party  $A$  solves the following problem:

$$\max_{g^A} p^A(g^A, g^B) = \frac{1}{2} + \frac{\psi}{\alpha'} [W'(g^A) - W'(g^B)] \quad (11)$$

Subject to:  $0 \leq g^A \leq y$ .

Moreover, party  $B$  solves a completely similar problem. The solution to this platform announcement simultaneous game yields the same dominant strategy to both parties, given below, where  $y' = \frac{\sum_J \alpha'^J y^J}{\sum_J \alpha'^J} = \frac{\sum_J \alpha'^J y^J}{\alpha'}$ .

$$g^A = g^B = g^E = (H')^{-1} \left( \frac{y'}{y} \right). \quad (12)$$

Note that income  $y' = \frac{\sum_J \alpha'^J y^J}{\sum_J \alpha'^J} = \frac{\sum_J \alpha'^J y^J}{\alpha'}$  is a convex combination of each income class' income, in which the weights are the percentage of citizens in each class that really vote. Therefore, the higher the political participation in one class, the higher the weight parties give to that class' income and, thereby, the closer the equilibrium policy will be to that class' preferred policy.

For the sake of illustration, suppose that  $\alpha'^P = \alpha'^M = 0$  and  $\alpha'^R > 0$ , i.e., only the rich citizens vote. Then,  $\alpha' = \alpha'^R$ ,  $y' = y^R$  and  $g^E = (H')^{-1} \left( \frac{y^R}{y} \right) = g^{*R}$ , so that the platform announced by each party is precisely the one preferred by the rich citizens. This explains again why there was so little redistribution in the past when voting rights were restricted to land owners.

### 3.4. The effect of electronic voting on the electoral equilibrium

Consider first the electoral equilibrium prior to EV. Recall that  $\alpha'^J = [1 - F(\kappa^J)]\alpha^J$ ,  $J = P, M, R$  and  $\kappa^P > \kappa^M, \kappa^R$ . Then we can write (with the subscript  $b$  for "before") as:

$$y'_b = \frac{\sum_J \alpha'^J y^J}{\alpha'} = \frac{\sum_J [1 - F(\kappa^J)] \alpha^J y^J}{\alpha'} > \sum_J \alpha^J y^J = y. \quad (13)$$

Since  $\alpha'^P < \alpha'^M, \alpha'^R$ , then it follows that  $g_a^E = (H')^{-1} \left( \frac{y'_a}{y} \right) < (H')^{-1}(1)$ , i.e., public goods provision before EV is below what it would be if all citizens were voting. This is a direct consequence of the fact that precisely the poor citizens, who prefer more public goods provision,

are the ones to present the lowest electoral participation.

Consider now the situation posterior to the introduction of EV. According to our model's assumption,  $\kappa^M$  and  $\kappa^R$  remain unchanged, whereas the cost parameter  $\kappa^P$  decreases to  $\tilde{\kappa}^P < \kappa^P$ . Then, using the subscript  $a$  for "after", we can write:

$$y'_a = \frac{[1-F(\tilde{\kappa}^P)]\alpha^P y^P + [1-F(\kappa^M)]\alpha^M y^M + [1-F(\kappa^R)]\alpha^R y^R}{[1-F(\tilde{\kappa}^P)]\alpha^P + [1-F(\kappa^M)]\alpha^M + [1-F(\kappa^R)]\alpha^R} < \frac{[1-F(\kappa^P)]\alpha^P y^P + [1-F(\kappa^M)]\alpha^M y^M + [1-F(\kappa^R)]\alpha^R y^R}{[1-F(\kappa^P)]\alpha^P + [1-F(\kappa^M)]\alpha^M + [1-F(\kappa^R)]\alpha^R} = y'_b. \quad (14)$$

$$\text{But then: } g_a^E = (H')^{-1} \left( \frac{y'_a}{y} \right) > (H')^{-1} \left( \frac{y'_b}{y} \right) = g_b^E.$$

In other words, the new voting technology brings about a reduction in the cost of voting to the poor, which increases their participation and, thereby, increases the weight of their preferences in parties' calculations, thereby increasing the equilibrium provision of public goods.

This is the main conclusion of the present theoretic model. The main theoretic insight is that increasing *de jure* access to voting, by legally extending the suffrage to poorer citizens, is not enough to ensure that the political parties will take these citizens' preferences into account. It is necessary that, in addition to having the right to vote, these citizens really exert that right. Only in the case where poorer citizens do participate strongly in the political arena by voting, will public policy reflect their preferences.

The main point of the present work is that, due to the high cost of voting to poorer, illiterate citizens in Brazil, their preferences were not fully considered until EV technology strongly increased their participation, changing the electoral equilibrium.

The empirical implication of the model and its testable hypotheses are straightforward: if the model does rightfully reflect the real situation, then, we should have observed a significant increase in the provision of public goods in Brazil after the implementation of EV. More specifically, since poorer citizens care more about social policy (health, education, cash transfers, etc.) we should have observed a clear increase in public spending in these areas.

The following sections test these hypotheses confirming that there was indeed a robust increase in social expenditure in Brazil after the advent of EV and that this increase is particularly strong in municipalities with higher numbers of illiterate citizens.

#### 4- Data

We use publicly available data on local government spending focusing social expenses related to health and education services, and public employment.<sup>23</sup> We also look at total budget, total expenses and receipt of intergovernmental transfers. Total budget and expenses shows the overall increase in social spending in response to enfranchisement. Intergovernmental transfers are selected because the Federal and State Representatives have connections with municipalities and disproportionately benefit the ones that are more likely to vote for them by sending these transfers (see Ferreira & Bugarin, 2007, Brollo & Nannicini, 2012 and Bugarin & Marciniuk, 2017 for a discussion on politically motivated transfers in Brazil). In addition, as discussed in Novaes (2015), mayors act as brokers for Representatives campaigning for them in exchange for financial support. Therefore, Representatives would be interested in transferring money to the municipalities with more valid votes to turnout ratio (positively related to EV usage), since the mayor will be able to deliver a larger number of votes in exchange for these transfers.

EV was first implemented in a federal election, however, we examine municipal level data. Therefore, we use the previous literature (Brollo and Nannicini 2012; Novaes 2015) to support our assumption that mayors respond to this election. To capture this mayoral behavior, we use the average spending in the two years following the federal elections and that are also the two years preceding the municipal ones. For instance, the 1998 federal elections' impact is measured by the

<sup>23</sup> The Brazilian National Treasury publishes detailed annual municipal expenditures. All variables on spending are in per capita values and have been deflated using the IGPM index (1994 is the base year).

average of the municipal public spending between 1999 and 2000. Places that used EV in 1998, and that therefore have extra political participation biased toward the poor, are expected to spend more on public goods provision between 1999 and 2000.

In addition to the dummy used to identify EV usage, we control for several confounding factors. Usage of EV is identified by the municipalities' total registered electorate in 1996.<sup>24</sup> The control variables are composed by: the percentage of votes for the incumbent mayor in the 1996 municipal elections; a dummy showing if the mayor's party is the same as the president or governor's coalitions at the time (for each respective state); the number of eligible voters; the average household monthly income per capita; the percentage of people living in rural areas; and the illiteracy rate.<sup>25</sup> Lastly, we use a municipality ideological index, which ranges from 0 to 10 (where 0 is extreme left wing and 10 extreme right wing), that can potentially explain differences in municipal level spending.<sup>26</sup>

## 5 - Two Stage Least Square Regression

### 5.1 Estimation Strategy

The natural regression to test the theoretical model presented in Section 3, would be the following one:

$$\ln Y_m = \alpha + \beta_1 V_m + \beta_2 X_m + \epsilon_m \quad (15)$$

where  $\ln Y_m$  is the logarithm of the average social spending between 1999 and 2000 in municipality  $m$ ,  $V_m$  is the valid votes to turnout ratio for State Representatives in 1998,  $X_m$  contains the control variables and  $\epsilon_m$  is the error term.

Two problems may arise with this model. First, the social spending between 1999 and 2000 may be correlated to past social spending which in turn increased  $V_m$ . For instance, suppose the spending in education between 1999 and 2000 is correlated to the spending in education in the past 10 years. If this is true, then previous spending on education would benefit the poor by giving them access to schooling and help them to be enfranchised as they could cast a vote. The estimated return to enfranchisement would then be biased due to this reverse causality – bringing an overestimated  $\beta_1$ . Secondly, omitted variables such as the measurement of the median voter income may also bias the results. Valid votes by itself may not show poor voter enfranchisement. It could be the case that the municipality has a large valid vote to turnout ratio because most citizens are rich and can therefore cast a vote. This could underestimate our results since large number of valid votes would show smaller preferences for redistribution.

To solve these problems, we estimate the following 2SLS model:

$$V_m = \mu + \pi_1 D_m + \pi_2 X_m + u_m \quad (16)$$

$$\ln Y_m = \delta + \lambda V_m + \Lambda X_m + \epsilon_m \quad (17)$$

where  $D_m$  is a dummy variable indicating if municipality  $m$  used EV. The difference between equations (15) and (17) is that  $\lambda$  measures the impact of the estimated valid votes to turnout ratio captured by equation (16). Therefore, the instrumented valid votes to turnout ratio in equation (17) impacts social spending only through the enfranchisement brought by EV that is biased toward the poor voters. Since the number of eligible voters is related to EV usage, there are no controls for number of voters. To compensate for this fact, the regressions are restrained to a small interval close to the cutoff for EV usage (40,500 voters) so the municipalities can be comparable.<sup>27</sup> The

<sup>24</sup> Information on electorate in each municipality was obtained from the Supreme Electoral Court (TSE)

<sup>25</sup> Data on electoral outcomes and mayor's party affiliation were obtained from the TSE. The demographic data were made available by Ipeadata, and are based on the decennial data collected in 1991 and 2000. Therefore, 1991 and 2000 has become a proxy for 1994 and 1998 respectively.

<sup>26</sup> The construction of this index can be found at Schneider (2016).

<sup>27</sup> Note that municipalities belonging to the four states mentioned earlier (Rio de Janeiro, Amapá, Roraima and Alagoas), used EV even if they had less 40,500 voters.

results are presented next.

## 5.2 Results

Table 1 shows the estimations for a closed interval of municipalities containing between 35,500 and 45,500 voters.<sup>28</sup> An increase of 1 p.p. in the valid votes to turnout ratio increases health spending by 1.65%; public employment by 0.71%; total spending by 1%; total revenue by 0.95% and intergovernmental transfer by 1.5%. Although the municipalities are likely to be similar, one can still argue that the results are driven by the lack of control for population. However, we performed a robustness check that shows how replicating our 2SLS analysis, but using the municipal social spending variables after the 1994 (no EV) and 2002 (only EV) elections as dependent variables shows no significant results. Details are available upon request.

The 2SLS estimates presented above empirically confirms the prediction of the model presented in section 3. However, it has some limitations. First, it has a small sample. Second, although the difference between the number of eligible voters is small across municipalities close to the cutoff, the regressions do not control for it due to the high correlation between the number of eligible voters and the instrument EV usage (correlation close to .70 for the 5,000 bandwidth considered). The differences-in-differences methodology is used next to check the robustness of the results by introducing a larger sample analysis.

## 6 - Differences-in-Differences

### 6.1 Estimation Strategy

An alternative way to test our hypothesis is to use the differences-in-difference (DID) methodology. As mentioned before, this method compares municipalities that used EV (the treatment group) to the ones that did not (the control group). It then presents the differences in public spending between two periods, before and after the EV usage, within these two groups as the following regression shows:

$$\ln(y_{it}) = \beta_0 X_{it} + \beta_1 (Year_t * EV_i) + \beta_3 Year + \beta_4 EV_i + \epsilon_{it}, \quad (18)$$

where  $Year_t$  is a dummy variable equal to 1 when  $t = 1998$  and  $EV_i$  is a dummy variable equal to 1 for municipalities that have used EV. For this estimation, we restrict the EV usage to the municipalities with less than 40,500 eligible voters and that belonged to the four states that had electronic voting in all its territory. Therefore, we can have a sample that covers most Brazilian municipalities and that at the same time have on average the same number of voters than the control group has.<sup>29</sup> The vector  $X_{it}$  includes all control variables that vary across time and municipalities (such as average income and number of eligible voters). The dependent variable  $y_{it}$  corresponds to the *per capita* social public spending (such as health and education) and  $\epsilon_{it}$  represents the error term. The coefficient  $\beta_1$  is the parameter of interest that captures the effect of EV on municipal public spending.

The following assumptions are made about the estimations. First, as the EV was implemented partly in the 1998 federal elections, we assume that the local administrations observe the change in the political participation for these elections and answer to it based on the median voter's choice. Second, we assume that non-observed variables that vary across time are orthogonal to the variable of interest.<sup>30</sup> Third, the selection of the four states which used EV in all their territories was not driven by political interests. As Fujiwara (2015) argue, there are no political motivation behind the EV usage selection.<sup>31</sup> Fourth, the control and treatment group do not present

<sup>28</sup> Increasing the interval to a bandwidth of 15,000 voters increases the significances of the results.

<sup>29</sup> If we were to consider all municipalities that used EV in 1998, our treatment group would have municipalities where the number of eligible voters will vary from 947 to 7,131,342. On the other hand, the control group will have less than 40,500 eligible voters in all its municipalities.

<sup>30</sup> See Angrist and Krueger (1999) for a complete discussion on the DID methodology.

<sup>31</sup> Fujiwara (2015) explain the four states selection as follows: "Two remote states largely covered by the Amazon forest (Amapá and Roraima) were chosen to check the electoral authority's ability to distribute EV in isolated areas,

significant differences due to the EV usage on variables that are not likely to be affected by it. Table 2 presents a balance check to support the argument.

Table 2 shows that EV impacted valid votes and voting turnout. EV increased valid votes to turnout ratio for federal and state representatives by 22 and 14 p.p. respectively. This result is close to the ones reported in the literature (Fujiwara 2015, Hidalgo 2010). EV did also decrease the turnout to electorate ratio by 6.8 p.p. This finding was previously reported by Schneider (2016) and we show later that it is not threatening our results.<sup>32</sup> Before testing whether EV usage affects public spending, Figure 3 (below) motivates the DID methodology we use.

Figure 3 shows that the average social spending (all variables considered) between 1999 and 2000 (year of the municipal election) disproportionately increased on municipalities using EV in 1998. It is noteworthy that the social spending before 1998 (for most variables with exception of health and public employment) was disproportionately larger on municipalities that did not use EV making stronger the argument that EV has changed the municipal social spending. In 2004, there is a clear pattern in public spending that is similar for both groups, which can be explained by the leveling on political participation in all municipalities brought by the general usage of EV since 2000.

## 6.2 Results

The DID estimation results are presented in Table 3. Columns (1), (2) and (3) show respectively, the results obtained for social spending on health, education and public employment. Columns (4) and (5) consider, respectively, municipal total spending and budget. Finally, Column (6) shows the intergovernmental transfers, both national and subnational (state), received by municipalities. EV usage increases total spending on health, education and public employment by 21, 14.5 and 18.5 percent respectively.<sup>33</sup> EV caused total spending, revenue and intergovernmental transfers to increase by 17.7, 15 and 15.5 percent respectively.

The intergovernmental transfers variable helps to explain how municipalities can get more revenue to spend on social expenditures. As Brollo and Nannicini (2012) argue, these transfers are extremely relevant since it accounts, on average, for 65% of the municipal budget. However, parts of these transfers are constitutional automatic transfers such as the Fundo de Participação dos Municípios (FPM), main source of revenue for small municipalities.<sup>34</sup> Therefore, we control for the FPM in our Table 3 estimates. Using FPM as control made our estimates larger in magnitudes, showing evidence that not taking this transfer into account downward bias the results.

Table 3 results are close to the ones presented on Table 1. An interesting exercise we propose is to consider Table 2 estimations, showing an increase of 14 p.p. in the valid votes to turnout ratio for State Representatives, and plug this value on Table 1. This gives the following result: An increase of 14 p.p. in the valid votes to turnout ratio increases health spending by 23.1%; public employment by 10%; total spending by 13.9%; total revenue by 13.3% and intergovernmental transfer by 20.3%. This exercise shows that both Tables 1 and 3 present a similar estimation of the response of public spending to political participation, even though they use different data. This provides external validity to our 2SLS estimations, increasing the robustness of our results.

Finally, we address the problem of lower turnout caused by EV as presented in Table 2. Schneider (2016) argues that EV caused lower turnout specially on places where clientelism is

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while the states of Rio de Janeiro and Alagoas had areas where the army provided security to election officials, allowing an opportunity to check the logistics of distributing the electronic devices jointly with the military” (p.431).

<sup>32</sup> This should be a concern to our measurement because the turnout was reduced especially in places where clientelism is stronger (Schneider 2016), which are poorer municipalities. Therefore, our estimations could be underestimated as the impact of EV on social spending would be even larger had those poorer voters participated in the election. This will be further discussed in this section.

<sup>33</sup> A 21% increase on health spending, for instance, would be equivalent to an increase of 24.75R\$ (or 12\$) per capita.

<sup>34</sup> According to IBGE (the Brazilian institute of geography and statistics), municipalities with less than 5,000 citizens, between 1998 and 2000, got on average 57.3% of their revenue from FPM.

strong, which are largely composed by poorer municipalities. To test if this is also the case for our restricted sample, we measure whether turnout had a larger decrease on places with below median income.

Table 4 indicates that EV only affected voting turnout of poorer municipalities. As column 1 shows, there was no change in turnout in municipalities with above-median income. However, these places had a large increase in enfranchisement (close to 20 p.p. increase in valid votes to turnout ratio). Places with below median income had a large decrease in turnout caused by EV (close to 12 p.p.), together with an increase in valid votes to turnout ratio (25 p.p.).

Schneider's (2016) argument holds in our restricted sample and allow us to isolate the impact of enfranchisement on social spending if we consider only the above median income municipalities, which had no change in turnout. By splitting the sample between above- and below-median income we show, in Table 5, that the EV impact on social spending is driven by above-median income (Panel A) municipalities. This finding indicates that our previous estimations (on Table 3) are underestimated because, as our model predicts, lower political participation biased toward poor places decreases social spending. Therefore, had the turnout in poorer municipalities not decreased due to EV, the increase in social spending would likely be larger.

Thus, section 6 confirms the results presented in section 5 and reinforces our model prediction that enfranchisement of the poor increases social spending. In addition, we provide evidence that the decrease in turnout caused by EV, if anything, downward bias our estimations.

## 7 – Conclusion

The connection between democracy and representation lies at the foundation of political participation and liberties. If participation is widespread and voters are free to express their choices, then elected policy makers will act in the best interest of the people. Consequently, institutions and rules are often devised to encourage civic involvement in politics and to promote freely contested elections. For instance, democracies promote participation by holding elections on holidays or weekends, permitting absentee and early voting, and creating initiatives such as the prominent Get-Out-The-Vote (GOTV) campaign (see Bugarin and Portugal 2015, Berinsky, Burns and Traugott 2001, Berinsky, 2005).

Nonetheless, campaigns to increase voting participation as absentee and early voting as well as GOTV, mostly increases the participation of the rich and the impact of enfranchising poor voters is still unknown.<sup>35</sup> This paper shows that voters' enfranchisement in Brazil, concentrated on the poor and illiterates that were no longer required to write in the ballot after the electronic voting (EV) introduction, increased social spending. Our results indicate that public spending on health, education and public employment increased by 21, 14.5 and 18.5% respectively. In addition, municipalities total spending, total revenue and total intergovernmental transfers also disproportionately increased in municipalities using EV by 17.7, 15 and 15.5% respectively. This empirical result corroborates our model prediction suggesting larger public provision in municipalities using EV.

This paper also considered Schneider's (2016) finding that EV reduced turnout in areas where clientelism is stronger (poorer places). Our investigation shows that lower turnout in poorer municipalities made our findings, if anything, underestimated. Therefore, had EV not changed turnout, the impact of EV on social spending would be even larger than the number we find. The main contribution of the present work is, therefore, to show the consequences of *de facto* enfranchisement on public spending and shed a light on the impact of larger turnout in democracies where vote is not mandatory. When electoral participation in a country is low, the level of public spending might not represent the choice of the majority diminishing the strength of the democracy.

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<sup>35</sup> Berinsky, Burns and Traugott 2001, Berinsky, 2005.

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Table 1 – Enfranchisement of the poor and local government finances, 2SLS estimates

VARIABLES	(1) Health	(2) Education	(3) Public Employment	(4) Total Spending	(5) Total Budget	(6) Intergov. Transfers
$V_m$	1.657** (0.672)	0.319 (0.519)	0.714* (0.392)	0.991** (0.437)	0.951** (0.426)	1.449*** (0.375)
Observations	116	116	115	116	116	116
R-squared	0.557	0.572	0.652	0.612	0.583	0.495

Notes: Robust standard errors clustered at the Brazilian state level are reported in parenthesis. All regressions control for average household monthly income per capita and use state fixed effects. Regression (1), (2), (3), (4), (5), and (6) consider the logarithm of per capita municipal spending on health; education; public employment, total spending, total revenue and total intergovernmental current transfers. All regressions use a bandwidth of 5,000 voters. \*\*\* p<0,01, \*\* p<0,05, \* p<0,1.

Table 2 – DID estimation showing that the treatment and control group have not changed across periods

VARIABLES	(1) Valid Votes Fed.	(2) Valid Votes St.	(3) Rural	(4) Income	(5) Voters	(6) HDI	(7) Illiterates	(8) Turnout
EV*Year=1998	0.230*** (0.037)	0.144*** (0.029)	0.026 (0.035)	-14.807 (16.832)	368.827 (415.933)	0.005 (0.009)	-1.718 (1.622)	-0.068** (0.033)
Observations	9,760	9,760	10,222	10,222	9,761	10,222	10,222	9,761
R-squared	0.885	0.888	0.940	0.936	0.987	0.983	0.969	0.900

Notes: All regressions use municipalities fixed effects. Standard errors, clustered by mesoregions, are presented in parenthesis. All regressions are controlled for a dummy identifying EV usage and a dummy identifying the year of EV usage. Columns (1), (2), (3), (4), (5), (6), (7) and (8) consider the dependent variable to be respectively: valid votes to turnout ratio for federal representatives; state representatives; percentage of people in the municipality living on rural areas; average income; number of voters; human development index; percentage of illiterate adults; turnout to electorate ratio. The sample considers municipalities with more than 1245 and less than 40500 voters. \*\*\* p<0,01, \*\* p<0,05, \* p<0,1.

Table 3 - Estimating the impact of EV usage on public spending

VARIABLES	(1) Health	(2) Education	(3) Public Employment	(4) Total spending	(5) Total revenue	(6) Intergov. transfers
EV*Year=1998	0.209** (0.099)	0.145*** (0.053)	0.185* (0.096)	0.177*** (0.054)	0.150** (0.061)	0.155*** (0.036)
Observations	8,102	8,124	9,386	9,051	9,053	9,393
R-squared	0.806	0.860	0.895	0.917	0.941	0.951

Notes: All regressions use municipalities fixed effects. Standard errors, clustered by mesoregions, are presented in parenthesis. All regressions are controlled for income, population and FPM transfers. Regression (1), (2), (3), (4), (5), and (6) consider the logarithm of per capita municipal spending on health; education; public employment; total spending, total revenue and total intergovernmental current transfers. The DID regressions comparing social spending between 1995-1996 and 1999-2000. The sample considers municipalities with more than 1245 and less than 40500 voters. \*\*\* p<0,01, \*\* p<0,05, \* p<0,1.

Table 4 - Estimating the impact of EV usage on turnout and valid votes to turnout ratio

VARIABLES	Turnout		Valid votes to turnout ratio	
	Above-median Income	Below-median Income	Above-median Income	Below-median Income
EV*Year=1998	-0.001 (0.026)	-0.118*** (0.018)	0.204*** (0.024)	0.255*** (0.053)

Observations	4,982	4,732	4,982	4,731
R-squared	0.932	0.845	0.897	0.878

Notes: All regressions use municipalities fixed effects. Standard errors, clustered by mesoregion, are presented in parenthesis. All regressions are controlled for income and population. Columns (1) and (2) consider the different impact of EV on turnout between above and below-median income. Columns (3) and (4) consider the different impact of EV on valid votes to turnout ratio between above and below-median income. The sample considers municipalities with more than 1245 and less than 40500 voters. \*\*\* p<0,01, \*\* p<0,05, \* p<0,1.

Table 5 - Estimating the impact of EV usage on public spending (splitting the sample between above and below-median income).

VARIABLES	(1) Health	(2) Education	(3) Public employment	(4) Total spending	(5) Total revenue	(6) Intergovernmental transfers
Panel A: Above-median income						
EV*Year=1998	0.268* (0.157)	0.176* (0.089)	0.119 (0.114)	0.272*** (0.089)	0.275*** (0.085)	0.209*** (0.065)
Observations	4,080	4,090	4,880	4,578	4,579	4,883
R-squared	0.826	0.887	0.882	0.915	0.944	0.947
Panel B: Below-median income						
EV*Year=1998	0.118 (0.107)	0.080 (0.073)	0.112 (0.120)	0.064 (0.058)	0.015 (0.057)	0.066* (0.039)
Observations	4,022	4,034	4,506	4,473	4,474	4,510
R-squared	0.765	0.823	0.882	0.903	0.939	0.961

Notes: All regressions use municipalities fixed effects. Standard errors, clustered by mesoregions, are presented in parenthesis. All regressions are controlled for income, population and FPM transfers. Regression (1), (2), (3), (4), (5), and (6) consider the logarithm of per capita municipal spending on health; education; public employment, total spending, total revenue and total intergovernmental current transfers. The sample considers municipalities with more than 1245 and less than 40500 voters. \*\*\* p<0,01, \*\* p<0,05, \* p<0,1.

Figure 1: Brazilian elections' timeline

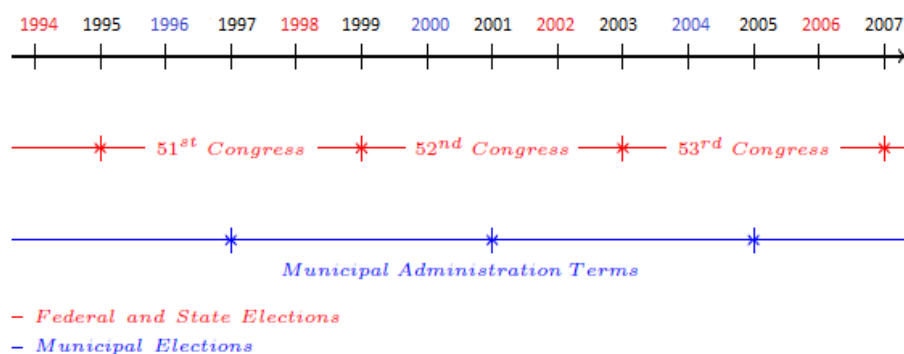


Figure 2 - The electoral competition game

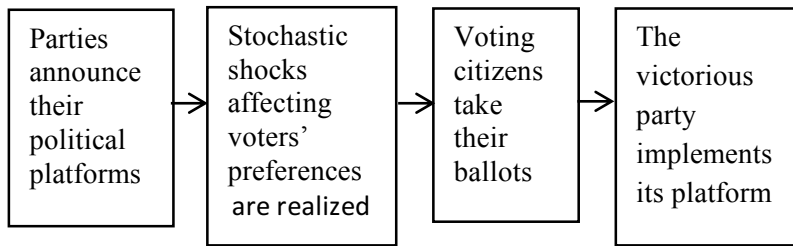
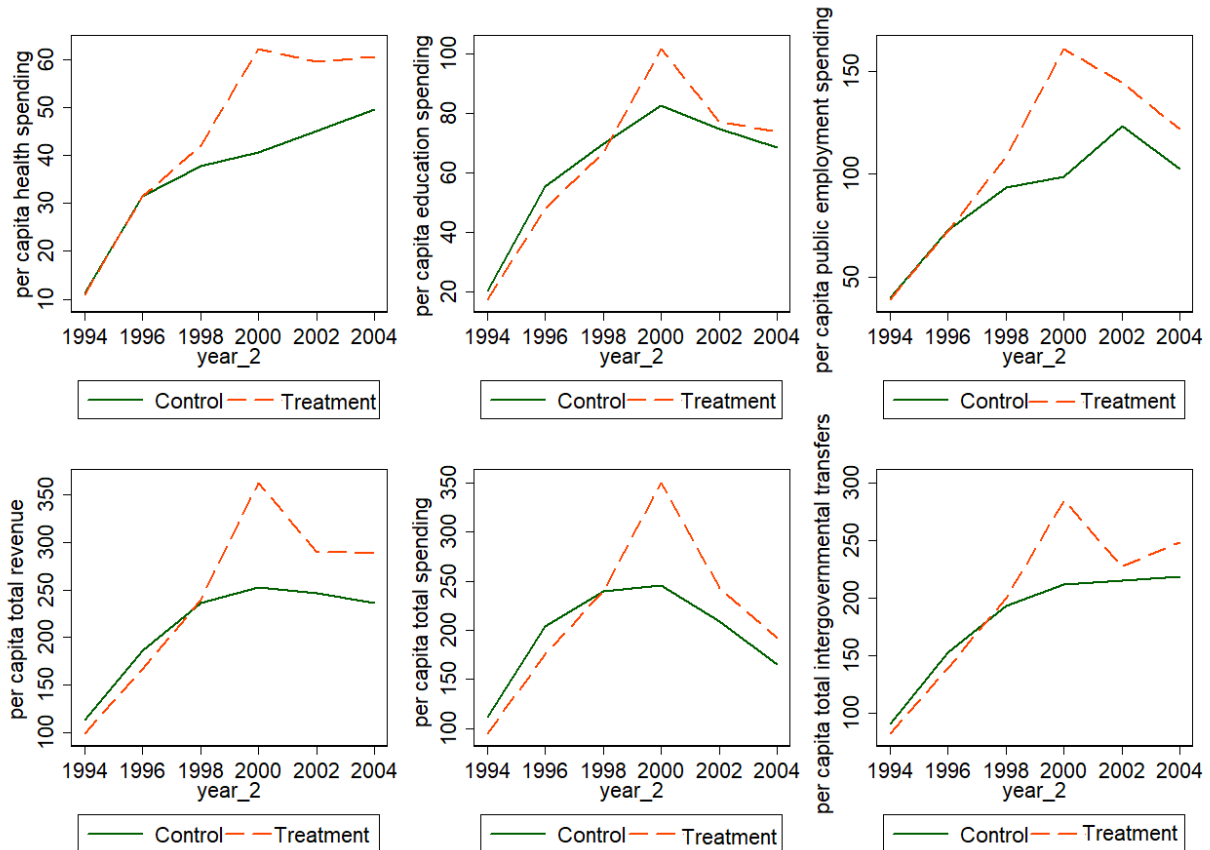


Figure 3 – Per capita public social spending between 1993 and 2004



Notes: All graphs show the public spending average of municipalities that used EV in 1998 (treatment) and the ones that did not (control). All data points represent a two-year average of total spending (e.g. the year 2000 contains the average spending between 1999 and 2000) and all values are deflated. The smallest 10% municipalities were dropped to attenuate the per capita spending on the smallest municipalities. The analysis is restricted to municipalities with less than 40,500 voters. 4577 municipalities (82% of the total Brazilian municipalities) are covered in this representation.